THE MECHANIZATION OF THE CERAMIC INDUSTRY

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The Industrial Revolution was and is considered a most important event in the transformation not only of manufacturing technique but also of our social life into the complex system of today. However, this "revolution" is by no means over or history as is borne out by the new technique of warfare exemplified in the war in Europe. But armies and navies and airforces aren't the only things which are finding the necessity or desirability of such mechanization although they are receiving the most attention at the present time.

The ceramic industry, which has been somewhat slower in adopting mechanization than some of the other major industries, is now realizing the importance of such a process, and many wonderful inventions and adaptions are being made available to the industry to permit it to become thoroughly mechanized.

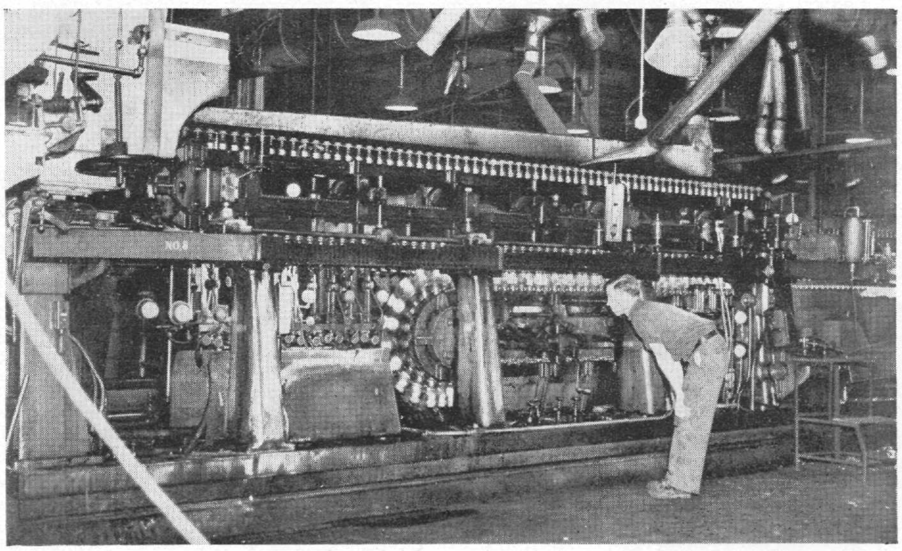
Naturally, it would be difficult to fully describe the many mechanical processes which have been introduced in recent years; therefore, it is hoped that by briefly describing a few of the more important of these, to present a cross section sampling of them as it were, that the trend towards the use of machinery in ceramic plants will be revealed.

The whiteware field, which includes dinnerware, pottery, sanitary ware, and porcelains, has had many radical improvements in recent years which tend to augment or entirely replace manual labor.

In the making of dinnerware the old practice was to mix the clay with water in blungers, filter press this fluid slip into a plastic solid, and pug the clay to the required plasticity. The clay mass was then delivered to a jiggerman, who had served years in the trade before perfection was obtained, and his helpers. One helper would work the clay mass to the desired properties and cut it into bats. These were then forced into a plaster mold which formed the required shape, and the mold was placed on the potter's wheel which revolved while the jiggerman would lower the arm on the profile tool which cut off the excess clay and finished the ware. This process required much hand labor and excessive time compared to the new automatic jiggering process.

In this process the preliminary preparation of the clay is the same; however, from the point of pugging the clay on to the finishing of the unfired ware, the machine is the master and slave, doing all of the work, faster and better.

The pug mill extrudes a plastic clay column at a pressure of 1200 pounds per square inch into a steel tube, and this pressure backs up a hydraulic ram



Courtesy "The Glass Industry"

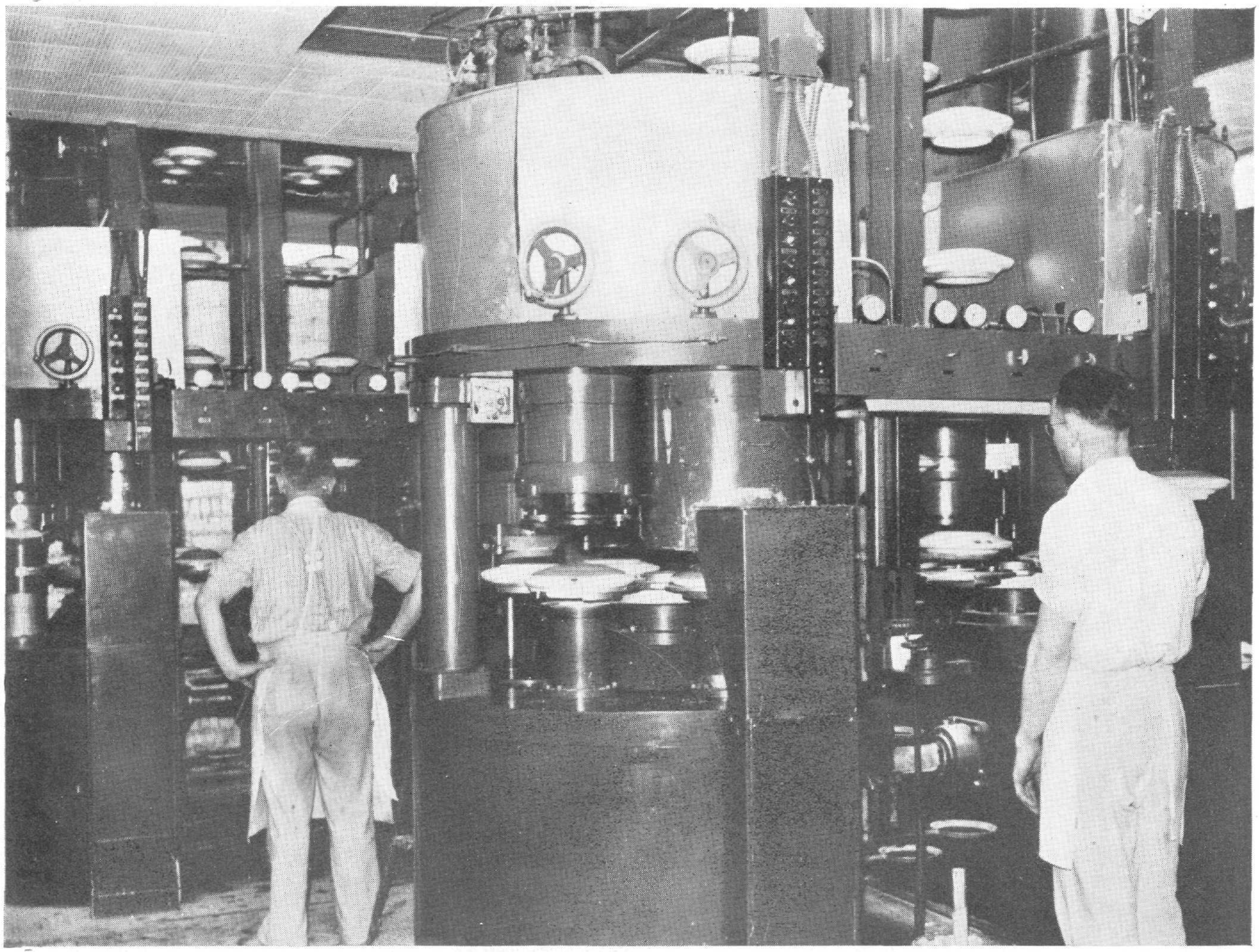
The Ribbon Machine For Glass Production

thereby permitting the clay to enter at uniform pressure and excludes all air. Both ends of the filled tube are sealed with rubber caps to prevent moisture escapage and are then used to supply the jiggering machines as needed.

The pressure in these clay tubes is accurately controlled by pumps and the amount of clay forced from them is thereby regulated. The jiggering machine consists of six arms about a central circular turntable. Each machine is composed of two units which produce ware simultaneously. In operation these arms pick up the empty plaster molds from the vertically moving conveyors returning the empty molds from the drier. Another arm is meanwhile receiving a clay bat of controlled weight which is cut from the extruded column by wire synchronized with the turntable operation. The next operation consists of a preliminary forming operation performed by the arm rising about four inches from its normal position against a heated brass mold which causes the plastic clay to completely fill the mold. The next arm holds the piece against a revolving steel profile tool which forms the piece and shaves off the excess clay. A fine spray of water is shot on the ware to lubricate the jigger. All excess clay is washed away by a high pressure jet of warm water and this is reclaimed for use. After the piece is formed, each of the twin units places its finished ware on to pairs of mold rings attached perpendicularly from the vertical conveyors.

The process is continuous as after forming, the molds pass through the drier on a chain conveyor and are transported to stripping stations where men remove the ware without disturbing the mold, place them in piles of twelve on to another conveyor which in turn takes the ware to the finishers. Incorporated with the use of automatic glazing machines which similarly handle ware at breathtaking speeds, the whole production process is one where the machine is supreme.

This process is capable of producing 20 to 23 pieces per minute, or with three machines (two units per machine) operating on a 24 hour schedule, 172,800 to 198,720 units per day depending upon the size of product desired. Not only is this production far superior to anything accomplished by hand processes,



Automatic Jiggering Machine Courtesy "Ceramic Industry" but better controlled ware, longer mold life, and better continuity of manufacturing is obtained.

In the sanitary pottery manufacture the old method of casting the tanks has been mechanized by a "merry-go-round" method of production.

The tank molds are set on sleds which ride about a roller conveyor in a closed circuit. At one end the mold is rebuilt after the tank is removed while an automatic lift raises the mold core into a sheet metal, overhead chamber. Automatic spray guns completely coat the core with a solution which prevents the cores from sticking to the ware upon removal. The core is set in place and the mold pushed until it is in position to be filled with the liquid slip. When full, they are guided into a portion of the conveyor which periodically pushes this mold against those preceding it and forces the whole line of molds to move along the track. Further down the line, the cores are pulled from the mold with an automatic lift suspended on an overhead monorail and set upon the top of the mold. After drying for a short time, the core is similarly lifted off while the flush and bolt holes are punched and then replaced on top as before. The molds then continue to follow the conveyor track until they again reach the casting position, being dried meanwhile by the warm air circulated by fans. By this time they are dry enough to remove from the mold. The mold is broken down, the tank is removed and placed on a side conveyor which takes the tanks to the finishers.

About 175 tank molds are on the track, and 160 tanks are cast every eight hour turn or 480 per day.

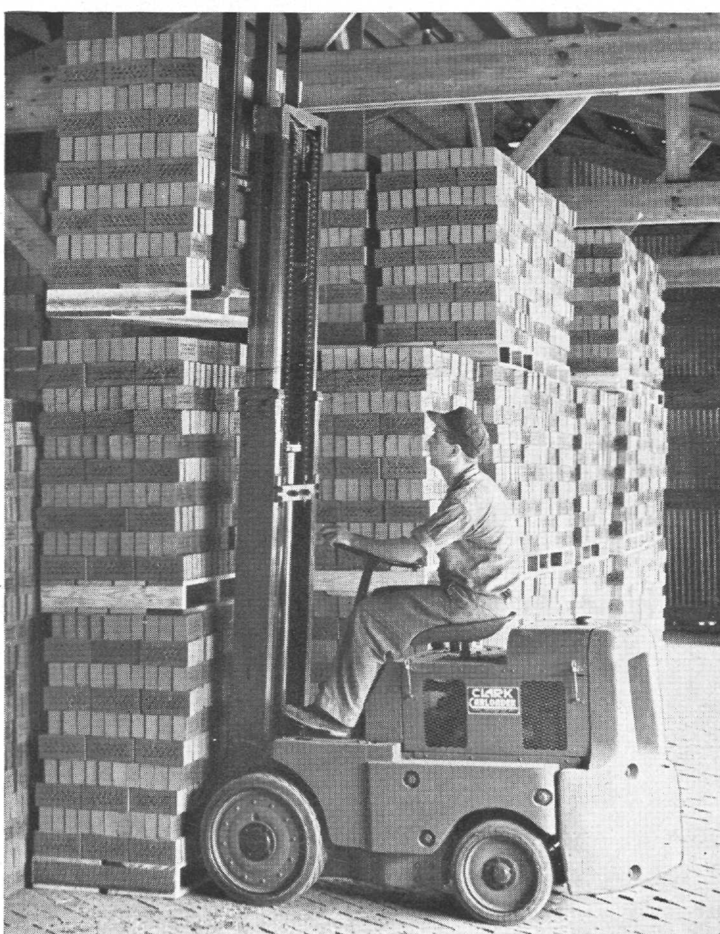
This process has the advantage of greater production, saving of manual labor, and a great savings in floor space.

The brick maker has come a long way from the days of hand made brick with the use of crushers, dry mixers, puggers, and brick extrusion and cutting machines. However, a new phase of mechanization has recently appeared which promises further reduction of tedious hand labor.

The handling of brick has long been accomplished by wheelbarrow, loaded, pushed, and unloaded by man. Recently, a new lift truck has been introduced which dispenses with these operations. It is a gasoline propelled truck with a hydraulic lift fork which carries the piled brick from the kiln to the box car, truck, or storage. The bricks are piled on pallets, ten at a time, 600 to a pallet, and the fingers reach under the pallet, lift the load from the ground, and the truck carries them to their destination. The hydraulic lift can raise the pallets to a height of 108 inches in 25 seconds with a load of 3300 pounds of bricks. The lift can be tilted 3 degrees forward or 10 degrees backwards, possesses a low center of gravity, short turning radius, a speed from one to seven miles per hour, and is easily operated by one man.

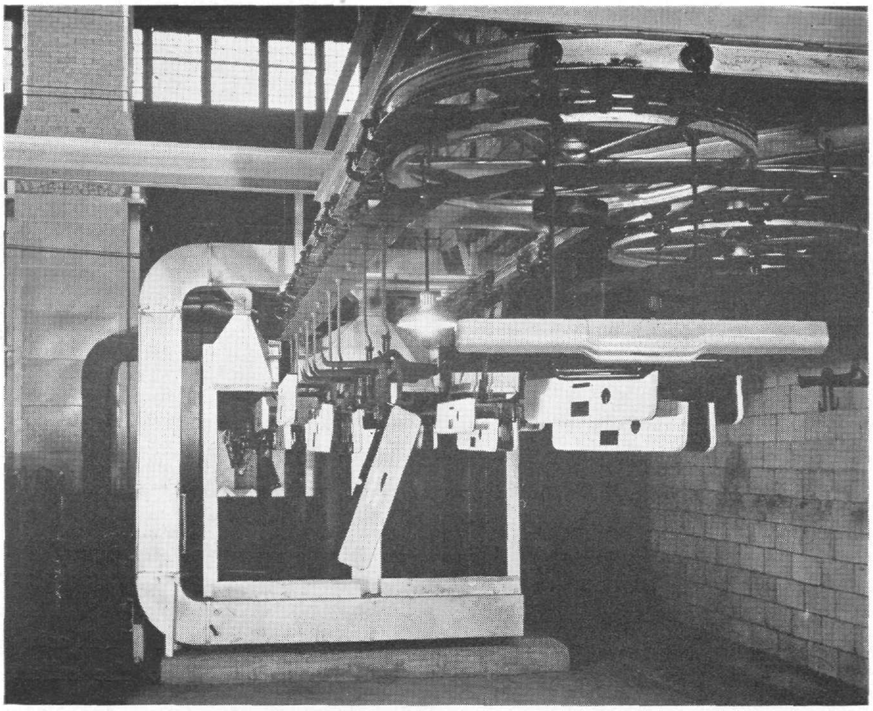
This truck releases many men to more productive work. It saves time, labor, floorspace in storage rooms, compensation insurance, and material losses of the ware.

Tunnel kilns have been used for several years in the ceramic industry, but they have been limited to burning natural gas or fuel oils. However, in brick and tile manufacture; the heavy weight and low unit value of the product have limited the firing process to the cheapest of fuel which usually is coal. Coal fired tun-

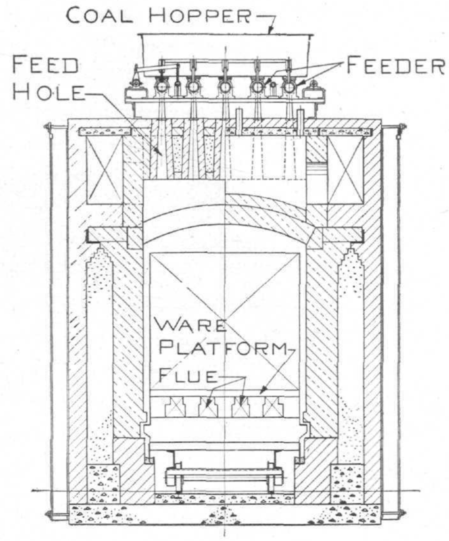


Rapid Loading

Courtesy Clark Truck Tractor Co.



Enameling Furnace Courtesy "The Enamelist"



Cross Section of Coal Fired Tunnel Kiln

Courtesy Swindell-Dressler Corp.

nel kilns have not been overly successful, as either hand firing or stoker firing has been employed. This necessitates the use of fire boxes on both sides which requires the removal of ashes and other disadvantages.

A recent development uses a top fired tunnel kiln principle with coal as the fuel and does so without the inherent disadvantages of coal burning.

The preheating and cooling zones are of conventional design; however, the furnace zone is provided with a series of evenly spaced rows of feeder holes on the top of the kiln through which the coal is fed.

The loading of the cars is changed by carrying two to three stacks of ware arranged crosswise to the car separated by approximately 12 inches.

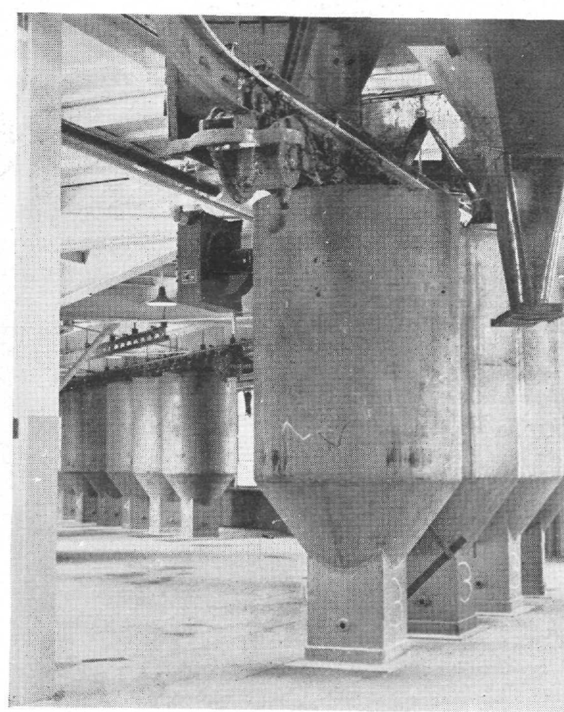
The rows of feeder holes are spaced so as to register with these spaces in the setting of the kiln cars. The train of cars moves until the proper alignment is attained and then stops while the coal drops into these spaces and burns. The train then moves forward one space setting during which time the coal does not feed into the kiln. Thus, with this controlled intermittent forward motion, the ware is fired through the kiln.

Each row of feeders is supplied from a hopper placed crosswise on the kiln. All of the feeders are worked from a single drive unit located at the end of one set. Each hole feeder and each row of feeders can be so adjusted in the rate of coal feeding that any desired distribution of fuel can be obtained both in the length and width of the firing zone.

The coal is carefully crushed in variable sizes and stored in a bunker above the kiln. Each hopper is filled as needed from a buggy running on a track in top of the kiln.

The finest particles burn in the top of the setting whereas the larger particles drop to the platform of the cars to burn. The ashes are easily removed by raking from the spaces on the cars when they are unloaded.

It is claimed that remarkable uniformity of ware, even heat distribution, elimination of fire boxes or grate maintenance, larger possible kiln width, no fly



Glass Batch Handlers

Courtesy "Glass Industry"

ash adhesion to the ware, and economy of coal as a fuel for firing is obtained.

The glass industry has become a symbol of intricate mechanical devices. Mechanization is employed in many phases of the industry, and the last twenty years has seen a pronounced trend towards the use of machinery of all varieties.

A mere two decades ago, shovels, wheelbarrows, and handcarts were deemed entirely adequate for the intermittent and small scale production rates then in use. However, with single melting units producing 50 to 120 tons of glass daily, mechanical handling processes have been the only salvation to meet this demand. Another advantage of this equipment has been to reduce the dust hazard.

Cullet handling, batch weighing and collecting, batch mixing and transport, furnace charging, and dust collecting, are all phases of glass plant material handling. These phases employ crushers, conveyors, elevators, mixers, automatic scales, hoists, screw conveyors, cranes, etc.

Of particular interest is the method of batch transport which employs several batch transport buckets gathered as a train and moved on overhead tramrails by means of an electric tractor. These provide excellent storage bins and prevent dust from contaminating the air. This system saves valuable floor space in addition to its other advantages of convenience, speed of transportation, and cleanliness.

The art of glass blowing was a skilled profession only a few decades ago, but now, owing to the development of high speed machines which render hand methods hopelessly outclassed, it remains only a novel and interesting demonstration like a side show.

Graduating from semi-automatic machines requiring hand feeding to completely automatic machines, the glass forming process has become a marvel of mechanization and amply demonstrates the ingenuity of man's inventiveness.

One machine can produce tumblers at the rate of 55 per minute! It consists of 12 similar sections revolving continuously on a turret and, as each section passes the feeding station, a gob of molten glass drops into the mold and is pressed into a parison with a bead. The mold drops away allowing the suspended parison to reheat and stretch. The paste mold comes up around the glass which is blown to fill the mold while oscillating. The mold then drops away and the finished product is removed to the lehr conveyor by a take-out device.

A recent advance was achieved in the evolution of the "ribbon" machine for glass production. The glass from the furnace is rolled into a ribbon of alternate thick and thin portions; the thick portions sag into holes in a plate attached to a chain which moves horizontally away from the furnace. A series of synchronized blow heads descend upon these thick portions and form parisons. A series of paste molds carried by a third chain below the glass envelops these parisons, and the glass is blown to fill the mold. The mold drops away, leaving the bulb still attached to the ribbon. At the receiver station, a plunger breaks these from the ribbon and delivers it to the conveyor, the remains of the ribbon being reclaimed as cullet. This machine manufactures bulbs at rates of 400 to 600 or more per minute.

The porcelain enameling industry has shown the most rapid growth of any in the ceramic industry. Much of this success is due to the modern equipment and mechanization employed.

One outstanding feature of an enameling plant is the use of overhead chain conveyors. These conveyors are used to transport the ware through the ground coat dipping room, driers, through the cover coat spraying booths, cover coat driers, the furnace, and finally to the inspectors and on to the assembling department or storage.

One novel feature uses two sets of cables which automatically transfers the ware from one to the other. In this way the conveyor which transports the ware through the spray booths does not enter the drier and permit enamel and dust to collect in the drier.

Automatic spraying equipment is constructed with a moving sprayer head which has four spray nozzles adjusted to give a flat, fan-shaped spray. The entire spraying assembly moves back and forth across the conveyor carrying the ware to be sprayed. This machine applies a smooth, uniform thickness of enamel to the passing ware.

In conclusion, it might be noted whereas all these processes of mechanization seemingly replace men from their jobs, the real effect is usually the opposite in the long run. That is, they not only make the industry more efficient but also cut down production costs thereby reducing the unit cost of the finished product. This in turn results in increased production and consequently a greater demand for labor.

Thus, the old potter must discard his potter's wheel; the glass blower, his pipe; the wheelbarrow, shovel, the broom are all becoming antiquated as the machine moves in on the ceramic industry.

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